

Mystery of bat with an extraordinary nose solved

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These images are of the noseleaf of a typical horseshoe bat species (left) vs. that of Bourret's horseshoe bat, the *Rhinolophus paradoxolophus* (right). Computer modeling indicates the extreme nose is used to create a highly focused sonar beam. One of the researchers is Rolf Mueller, an associate professor with the Virginia Tech mechanical engineering department, who directs the Bio-inspired Technology Laboratory. His research includes biosonar-inspired autonomous robots and statistical signal processing methods in natural outdoor environments. Credit: Rolf Mueller

A research paper co-written by a Virginia Tech faculty member explains a 60-year mystery behind a rare bat's nose that is unusually large for its species. The findings soon will be published in the scientific trade journal, *Physical Review Letters*.

The article, "Acoustic effects accurately predict an extreme case of biological morphology," by Z. Zhang, R. Müller, and S.N. Truong,

details the adult Bourret's horseshoe bat (known scientifically as the "Rhinolophus paradoxolophus," meaning paradoxical crest), and it's roughly 9 millimeters in length [nose](#). The typical horseshoe bat's nose is half that long, said Rolf Mueller, an associate professor with the Virginia Tech mechanical engineering department and director for the Bio-inspired Technology (BIT) Laboratory in Danville, Va. "This nose is so much larger than anything else," among other bats of the region, he said.

Mueller's findings show that the bat uses its elongated nose to create a highly focused sonar beam. Bats detect their environment through ultrasonic beams, or sonar, emitted from their mouths -- or noses, as in the case of the paradoxolophus bat. The echoes of the sound wave convey a wealth of information on objects in the bat's environment. This bat from the remote rainforests of South East Asia received its name 58 years ago because of its mysterious trait.

Much like a flashlight with an adjuster that can create an intense but small beam of light, the bat's nose can create a small but intense sonar beam. Mueller and his team used computer animation to compare varying sizes of bat noses, from small noses on other bats to the large nose of the paradoxolophus bat. In what Mueller calls a perfect mark of evolution, he says his computer modeling shows the length of the paradoxolophus bat's nose stops at the exact point the sonar beam's focal point would become ineffective.

"By predicting the width of the ultrasonic beam for each of these nose lengths with a computational method, we found that the natural nose length has a special value: All shortened noses provided less focus of the ultrasonic beam, whereas artificially elongated noses provided only negligible additional benefits," Mueller said. "Hence, this unusual case of a biological shape can be predicted accurately from its physical function alone."

The findings with the paradoxolophus bat are part of a larger study of approximately 120 different bat species and how they use sonar to perceive their environment. Set to finish in February 2010, it is hoped the study's focus on wave-based sensing and communication in bats will help spur groundwork for innovations in cell phone and satellite communications, as well as naval surveillance technology.

The article will appear in [Physical Review Letters](#)' print edition on July 17 and on the Web site on July 14.

Source: Virginia Tech ([news](#) : [web](#))

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